GDE Change Evaluation Panel

TLCC-1 – Decision Memo

9 Nov 10

Proposal: Average Accelerator Gradient

"We propose to keep the specified ML accelerator operational gradient of ≥ 31.5 MV/m with Q_0 = ≥ 10^{10}, on average, with a gradient spread of less than ±20%."

Decision:

YES, with considerations below.

Discussion:

The interim TDP1 R&D milestone of cavity production yield, >50% at 35 MV/m (including cavities which have undergone a 2nd surface treatment and test process), has been achieved. Although the earliest of the 27 cavities processed according to the ILC prescription, produced by various vendors and processed at DESY or JLab, do not meet the goals, the last 10 cavities from ACCEL/RI and processed at JLab approach the final TDP R&D goal of 90% yield, admittedly with low statistics.

The low statistics make it difficult to develop a reliable model for extrapolations to performance during the construction phase, and therefore to make conclusions about cost savings or develop a strategy for processing/acceptance of cavities.

Some considerations and comments:

1) Is the 20% spread in acceptable gradients an achievable goal or can it be adjusted to optimize cavity yield / cost?
2) The average operating gradient is fixed to 31.5MV/m. How will the cavity spread be accommodated cavity-by-cavity and how will that impact the total costs due to increased total RF power? Will it be possible to make the adjustments remotely or will downtime be required? We evaluate the proposal as sound, as long as we take a forward-looking view. However ,we recognize that the gradient margin from vertical to horizontal has effectively become smaller. Requiring all cavities to surpass 35 MV/m in the vertical test, while more expensive than this proposal, provides a greater measure of risk mitigation against failure to attain 31.5 MV/m for operational cryomodules. Also the maximum RF power needed to be supplied to any cavity has increased to 31.5MV/m +20% = 38MV/m. There are several reasons for needing the gradient and power margin. While some (e.g., waveguide loss) are constant, others (such as gradient and the setting error of loaded Q) will vary from cavity to cavity. It is desirable to perform computer simulation, in spite of the many presently unknown factors. We suggest that simulations, such as those presented for DRFS by S. Michizono

at BAW-1 be extended and also that they also be done for KCS to study this issue.

3) Considering recent improvements, average cavity gradients higher than 35 MV/m may well be achieved for the TDR at the end of 2012. This should be encouraged in our plan and we endorse finding a way such that if successful, we would be able to take credit for a cost savings through shortening the linac for the TDR.
4) What new information will be available, and when, for the TDR? The primary potential source of new information will be from the XFEL for the cavities that use the ILC electropolishing procedures. What cavities will be available through XFEL or Hi Grade and how will this information be taken into account for TDR?
5) What should our reprocessing strategy be? Since it is proposed to accept cavities of 35 MV/m ± 20 % in the vertical test, should we reprocess only cavities that are below 28 MV/m, or continue to reprocess all cavities with first pass performance < 35 MV/m? The strategy should be optimized to minimize the total ILC costs, but that will require the accumulation of more cavity data to do this optimization. One way to approach the problem might be to take several different possible yield curves for both single and second processing and calculate the ILC cost with several assumptions on cavity spread that will be accepted and on criteria for reprocessing. Linac length could either be changed to maintain a constant total energy or the total energy available noted for each case. This could allow one to determine the best strategy for a given yield curve.
6) The goal of an average operational gradient (in cryomodules) of 31.5 MV/m represents a good balance between conservatism and optimism. We must still understand how to assure that the ratio between maximum cavity gradient performance in the installed cryomodule to the maximum gradient in vertical testing attains 90%
7) We find that this proposal is not controversial for the physics/detector community.